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CHAPTER 4

PAVEMENTS

4-1. General. Bituminous pavements provide a resilient, waterproof, load distributing medium that protects the base course from the detrimental effect of water and the abrasive action of traffic. Bituminous pavements are subject to maintenance due to wear, weathering, and deterioration from aging. Flexibility of bituminous pavement permits slight adjustments in the pavement structure, owing to consolidation of base course or effect of load, without detrimental effect. Hot-mix bituminous pavements will be designed by either the Marshall or gyratory method for normal traffic on roads and streets, using criteria for 100- or 200-psi tire pressure, as appropriate.

4-2. Bitumen. Bituminous materials used in paving are asphalt or tar products. Although asphalts and tars resemble each other in general appearance, they do not have the same physical or chemical characteristics. Tars are affected to a greater extent by temperature changes and weather conditions; however, they tend to have better adhesive and penetrating qualities than asphalts. Generally, asphalt seal coats and surface courses are preferable to tar seal coats and surface courses for roads. Generally, the heavier types and grades should be employed for the warm climates and the lighter types and grades for the cold climates.

4-3. Aggregates. The aggregates used in paving mixtures should conform to the pertinent specifications for durability, soundness, and other requirements. The aggregates used for tank roads must be crushed, processed material, except that fine aggregate portion of the mixture may contain percentages of natural sand.

a. Gradation. As a general rule, the maximum size of the aggregate in a course should not be more than one-half the finished thickness of the surface course or more than two-thirds the thickness of the intermediate or base courses.

b. Mineral filler. Mineral filler consists of processed materials such as limestone, portland cement, or other similar inert materials. Commercial fillers produced from limestone or other types of stone are readily available in most areas.

4-4. Hot-mix bituminous concrete pavements. Hot-mix bituminous concrete is a mixture composed of well-graded mineral aggregates, mineral filler, and bituminous cement and is particularly suitable for heavy-duty-traffic roads, streets, and storage areas. The procedures for the design of hot-mix bituminous concrete pavement are presented in EM 1110-3-141.

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4-5. Plant-mix cold-laid bituminous pavements. Cold-laid bituminous pavements are composed of a mixture of asphalt cement and liquefier, liquid asphalt, powdered asphalt and flux oil, emulsified asphalt or tar, and well-graded mineral aggregate. Normally, the aggregate gradings are the same as used for hot-mix asphaltic concrete. Cold-laid plant-mix bituminous concrete is similar to hot-mix bituminous concrete in appearance and general physical characteristics. A discussion of plant-mix cold-laid bituminous pavements, design and control, is presented in appendix A.

a. Main uses. In general, the cold-laid bituminous plant mixes are laid in the same manner and have the same paving uses as hot-mix bituminous concrete. They are specifically adaptable for patchwork and construction of small jobs such as open storage areas where the tonnage to be used does not justify the erection of a hot-mix plant. Cold-laid mixtures have special advantages in that they can be manufactured at a central plant and shipped by rail or truck to the site, and they can be purchased in small quantities. The specific types of cold-laid asphalt mixes that are considered satisfactory for paving roads and streets are as noted below.

b. Types.

(1) One type of cold-laid bituminous concrete is composed of graded mineral aggregate and liquid asphalt prepared in a standard paving plant. This type of pavement is commonly laid at or near normal atmospheric temperatures in the same manner as hot-mix bituminous concrete. Liquid asphalt mixtures require a curing period after mixing and prior to compaction to permit sufficient evaporation of the volatiles or excessive moisture to enable the mixture to gain sufficient stability to support the compaction rollers. Temperatures and moisture caused by rain will control the length of curing period. Aggregates for liquid asphalt mixes need to be heated only to the extent necessary to reduce their moisture content to 2 percent or less so they may be satisfactorily coated with liquid asphalt. In many cases, the moisture content can be reduced satisfactorily by exposure to sun and wind. The amount of asphalt required is, in general, the same as for hot-mix bituminous concrete.

(2) Other types of cold-laid bituminous pavements are prepared in a standard paving plant using aggregates, containing not over 2 percent moisture, sprayed with a liquefier and asphalt cement of 80 to 120 penetration. Sometimes a small percentage of lime, usually about 0.5 to 1.5 percent, is added prior to adding the asphalt. The lime, combined with the liquefier, assists in coating the aggregate with asphalt cement. The curing period can be reduced by regulating the amount of liquefier used. Emulsified asphalt and tar are also used for producing cold-laid plant mixes.

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4-6. Bituminous road mix. Bituminous road mixes are normally mixed in place by the use of travel plants or common types of road building equipment, such as, blade graders, disk harrows, drags, and pressure distributors.

a. Binders. The binders used in road mix construction may be either liquid asphalts, emulsified asphalts, or tars. The percentage of bitumen required is, in general, the same as for cold-laid bituminous concrete and depends upon the type and gradation of the aggregate used.

b. Aggregates. The aggregates used in road mixes may be existing subgrade materials, loosened existing subgrade materials blended with imported materials, or properly processed imported materials placed on the existing base or subgrade. The bitumen is normally applied by a pressure distributor to the processed aggregate on the base or subgrade and then thoroughly mixed with the aggregate.

4-7. Surface treatments, spray application. Surface treatments consist of a thin mat of mineral aggregate cemented together with various grades of bituminous materials. The bituminous material is applied by a pressure distributor to any prepared base, followed by an application of mineral aggregate of high quality, and finished by rolling. Surface treatments range from a light application of bituminous material followed by a light cover of sand and rolling to a succession of single treatments built up to various thicknesses, generally not exceeding 3/4 inch.

a. Grade. The quantity and type of bitumen and aggregate to be used for the treatment are dependent upon the condition of the pavement. The bitumen should be of such fluidity and character that it will readily bond the cover aggregate in a uniform layer.

b. Uses. Surface treatments are used for Class D and E roads and streets. Surface treatments provide wearing resistance as well as waterproofing to base courses and new pavements (such as plant-mixed cold-laid, mixed-in-place, and sand mixes). Multiple surface treatments are used to provide even greater wearing resistance and some structural strength.